

SCIENCE.

FRIDAY, FEBRUARY 25, 1887.

COMMENT AND CRITICISM.

THE FULL DISCUSSION, from both the economic and the commercial standpoints, that the interstate commerce bill has received in the United States, brought out the many points of contact between the railway problem as it presents itself to this and to other nations. We have had forced home upon us the conviction, that while local conditions may vary, yet the question at issue is substantially the same, whether it presents itself here or in Great Britain or Germany. For this reason the observations concerning the railways and transportation made by the British commission on the depression of trade — of whose report we present an account elsewhere — will be of interest to those who have studied the railway problem in the United States. The report of the majority of the commission finds, that, among all the causes which are said to have aggravated the prevailing depression, none has been so persistently put forward as the difficulties connected with the transportation of goods. The complaints made before the commission under this head are of three classes : “1°, that the railway companies regulate their charges so as to favor one district, or place, or trade, at the expense of another, and the importer of foreign goods at the expense of the home producer ; 2°, that the cost of transit in this country is excessive as compared with the charges made for similar services in other countries, and that consequently our home trade is being crippled or destroyed to the advantage of our foreign competitors, who are able to place their goods in our markets at a less expense than the home producers, who carry on their operations at a much less distance ; 3°, it is contended that if the water communications of the country were properly developed, an effective competition would thus be established which would regulate the monopoly now possessed by the railways.”

The report states, that, so far as the first of these points goes, even if proved, it could only account for a local and not for any such wide-spread depression as is found to prevail ; for what one trade

or locality loses, another must gain. Furthermore, if companies be compelled to withdraw the advantages complained of in the case of imported goods, what assurance is there that it may not be found necessary to follow the same treatment with goods intended for export, and, in fact, to abolish all through rates? In regard to the second point, it is admitted that railway transportation is cheaper on the continent than in Great Britain, because of the lower initial cost of the continental railways, and because the longer distances to be traversed there operate to reduce the rate per mile. But it is contended that the present rates — which have parliamentary sanction — only afford an average return of about four per cent on the capital invested, and consequently cannot be reduced. The commission adds that it is not so much the cheapness of land transportation on the continent that is felt, but the cheapness of the sea transportation between the continent and Great Britain : for the complaints arise principally from the inland towns which have no transport save that afforded by the railways, and consequently are at a disadvantage as compared with sea-coast towns. As this advantage in favor of the latter is perfectly natural, the commission finds no justification for interfering with it. On the third point both complainants and commission agree, and the latter recommends the adoption of measures which will permit of the free development of canals wherever they are likely to be useful and prevent their being controlled by the railway companies, as appears to be the case in many parts of the country.

THE BILL WHICH has been introduced in the assembly of the state of New York, entitled “An act to regulate the licensing and registration of physicians and surgeons, and to codify the medical laws of the state of New York,” is one which should meet with the hearty support of the medical profession, and receive the vote of every member of the legislature. That legislative action is necessary to codify the laws relating to medical practice is evident, when it is considered that there are at the present time fourteen or more such laws in force, some of them having been enacted as

long ago as 1806. The act now before the legislature repeals many of these laws entirely as well as the inconsistent and useless sections of the others. We have not had time to compare the proposed law with those which it will repeal, but as the act has been prepared by the counsel of the New York county medical society, who has probably had as much experience in these matters in the courts as any of the lawyers, we presume the repealing clause is right and proper. We are glad to see that provision is also made by which the question of registration will be settled, so that the practice of county clerks throughout the state will be uniform. It will hereafter be necessary for a physician to register in person in but one county, after which registration he will receive a certificate of registration from the county clerk. If he desires to remove his practice to another county, or to engage in practice or open an office therein, he may present his certificate in person to the clerk of that county, or mail it to him by registered letter. On this certificate the clerk will indorse, 'registered also in — county,' and the physician is then qualified to practise therein.

Another section of the law which is most equitable and just, and one which will remove all cause for doubtful interpretation of existing laws, is as follows: "Nothing in this act shall be construed to punish commissioned medical officers serving in the army or navy of the United States, or in the U. S. marine hospital service, while so commissioned, or any one while actually serving as a member of the resident medical staff of any legally incorporated hospital, or any legally qualified and registered dentist exclusively engaged in practising the art of dentistry, or any lawfully qualified physicians and surgeons residing in other states or counties meeting registered physicians and surgeons of this state in consultation, or any physician or surgeon residing on the border of a neighboring state, and duly authorized under the laws thereof to practise physic or surgery therein, whose practice extends into the limits of this state, providing that such practitioner shall not open an office or appoint a place to meet patients or receive calls within the limits of the state of New York; or physicians duly registered in one county of this state called to attend isolated cases in another county, but not residing or habitually practising therein." The other provisions of the law which are intended to punish all those who fraudulently practise medi-

cine, are also worthy of commendation. We sincerely trust that the whole bill will promptly pass both houses of the legislature and receive the signature of the governor.

CAPT. A. W. GREELY'S appointment as chief signal-officer with rank of brigadier-general is a well-merited promotion. It is also a compromise with those who have been advocating the separation of the service from the army; for, while the new chief is an army officer, he is also a man of scientific attainments and experience, and it was for the purpose of securing a person with the latter qualifications that the change was advocated. The appointment is also applauded by the President's friends as being in strict line of civil-service reform, as Captain Greely was next in rank in the bureau to General Hazen, and had worked long enough with him to understand fully the methods of the service. The general impression seems to be that the senate will confirm the nomination.

THE LATE ERUPTION FROM KILAUEA.

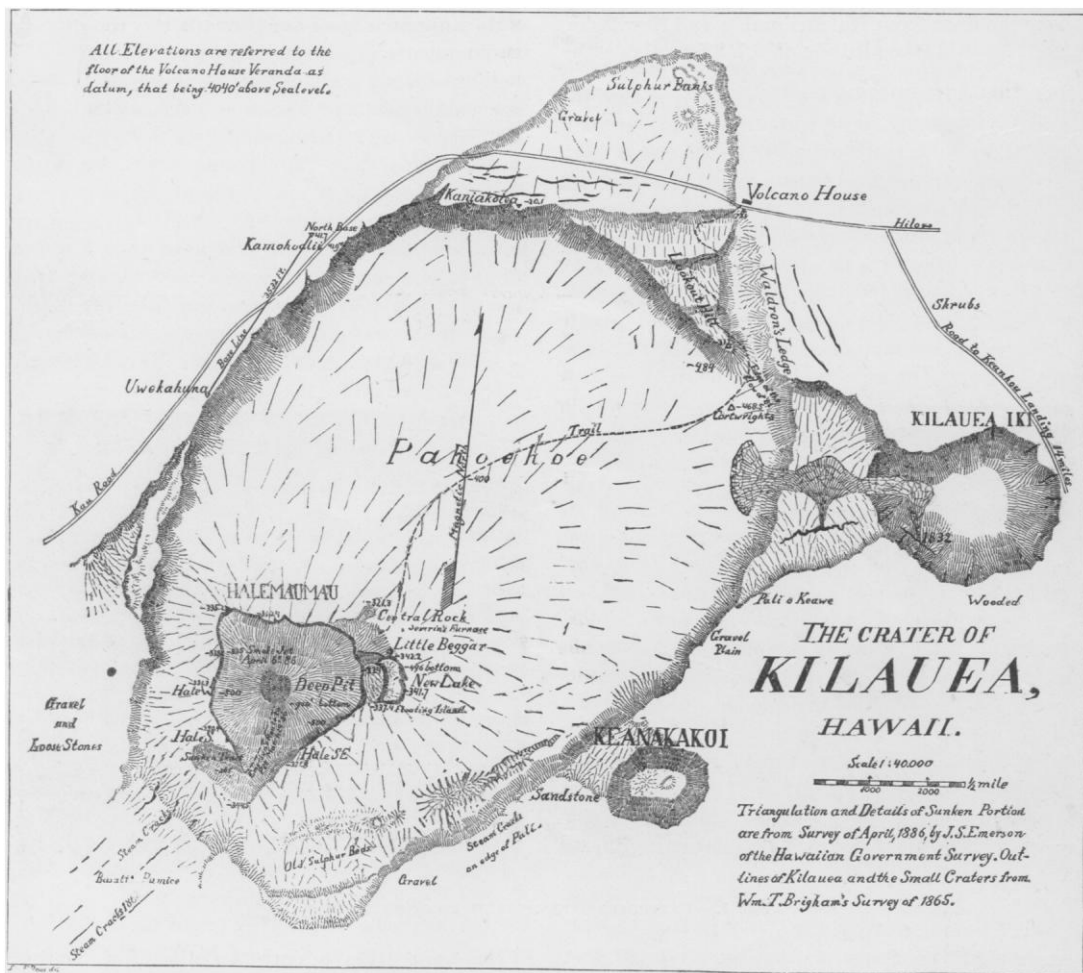
BECAUSE of the increased numbers of tourists, better facilities are now offered for visiting Kilauea. Instead of the arduous equestrian journey of thirty miles from Hilo, over rough lava, often in the midst of rain, the traveller can now disembark from the Kinau — the best of the inter-island steamers — at Keauhou on the dry side of Hawaii, and reach the Volcano House by a new road, only eighteen miles long, and that mostly in a carriage. Arrangements have been perfected by which the round trip can be taken from Honolulu in six days' time, allowing two nights and one and a half days at the caldera, and at a cost of sixty dollars.

The first recorded eruption from Kilauea was in 1789, when a troop of native soldiers were suffocated. The first scientific accounts are those of Ellis in 1823, and of the U.S. exploring expedition in 1840, as given by Commodore Wilkes and Prof. J. D. Dana. Since then the more notable changes have been recorded by Dr. Titus Coan in the columns of the *American journal of science*. In 1882 Capt. C. E. Dutton explored Kilauea and the Hawaiian Islands generally, presenting in the 'Fourth annual report of the U.S. geological survey' the best description of the volcanic phenomena of that part of the world that has yet appeared. In the following year, and also during the past summer, the writer went over the same ground.

Immediately after the disappearance of the lava in Kilauea in March last, Prof. W. D. Alexander, chief of the trigonometrical survey of the Hawaiian Islands, directed his assistants to make a plan of the disturbed region; and by his kindness we are permitted to present it to the readers of *Science*. The triangulation and details of the sunken portion are from the surveys of J. S.

between the large and small calderas. Captain Dutton copied these errors of Brigham into his report.

Commodore Wilkes prepared a map of Kilauea, delineating the main topographical features, and especially showing the 'black ledge,'—a shelf of desiccated lava from 600 to 2,000 feet in width, and about 660 feet below Uwakahuna, the



Emerson; the general outlines are from W. T. Brigham's survey of 1865, while the map was drawn by F. S. Dodge. The descriptive lettering is mostly taken from Brigham, with a few additions and improvements: for instance, the names of the small adjoining craters are altered to correspond with Hawaiian usage. The 'Kilauea Iki' of Brigham is changed to 'Keana Kakoi,' and 'Poli-o-keawe' is changed to 'Kilauea Iki.' The designation 'Poli-o-keawe' is applied to the shelf

highest point in the rim on the western side. It encircles a lower pit, 12,000 feet long, 3,000 feet wide, and 384 feet deep, which represents the dimensions of the block of melted lava that broke out twenty-seven miles distant, and then flowed twelve miles to the sea at Nanawali. The black ledge was still discernible in 1865, but has not been mentioned for the past ten years. The southern end of the deep pit represents the centre of activity, called 'Halema'uma'u.' From time to time tem-

porary lakes of fire appear on all sides, but Halema'uma'u remains essentially constant. This is a real crater, while Captain Dutton has well suggested the name of 'caldera' for the entire depression.

The entire pit was never fuller than on the evening of March 6, 1886. The lava that for nine years, or since the last previous important discharge (1877), had been accumulating and pouring over the floor from Halema'uma'u and New Lake, till it attained the altitude of 3,719 feet above the

some of them probably occasioned by the falling of large masses of rock. Shortly after midnight the lava disappeared through a subterranean channel, filling up some vacant chamber, probably, since it did not discharge anywhere at the surface, nor was there any oceanic disturbance within easy distance of the island. The thickness of the molten column that disappeared proves to be 570 feet, without estimating the additional distance to the unknown reservoir beneath the rough fallen fragments.



FIG. 1.—CAVITY ONCE OCCUPIED BY THE NEW LAKE.

sea-level. The floor was convex, and 160 feet higher at the lakes than at the northern edge, while the general level averaged from 150 to 200 feet above the black ledge of Wilkes. To the south the lava had risen upon the old sulphurbanks, nearly covering them, while leaving a long narrow promontory scarcely a dozen feet above the general level. Late in the evening there commenced a series of earthquakes, so severe as to alarm J. H. Maby, the landlord of the Volcano House, and his household. Up to 8 A.M. of the following day, forty-three shocks were noted,

The map gives a correct delineation of the sunken area. The main depression is roughly triangular, with sides about 3,350 feet long, forming an area less than half a mile square. In extent it is not very unlike Kilauea Iki, though the basin carries less cubical content. To the east of the principal depression is the space left by New Lake and Little Beggar, the smaller temporary craters. The average depth of this circular segment is 165 feet; the length, 1,700 feet; width, 250 to 650 feet. It is a sort of shelf or terrace adjoining the greater depression. The triangular pit

is very irregular, some portions of it equalling the New Lake terrace in altitude, while the deepest part is in the centre. The walls of the depression may now be called the 'black-ledge;' and their limited dimensions, as compared with the greater pit formed in 1840, will illustrate the littleness of the late discharge. Like the last, the next eruption may be expected after the new pit has been refilled.

The accompanying illustrations show the sunken

from its lowest point. The greatest depth exhibited is 570 feet.

Besides the formation of this pit, there were produced several large cracks in the neighborhood, — one on the Poli-o-keawe, at the sulphur-banks near the Volcano House; and two on the way to Keauhou, two miles distant.

Quietness and darkness reigned in this pit till the fourth day of June. Four days later we visited it, and found upon the east side of the

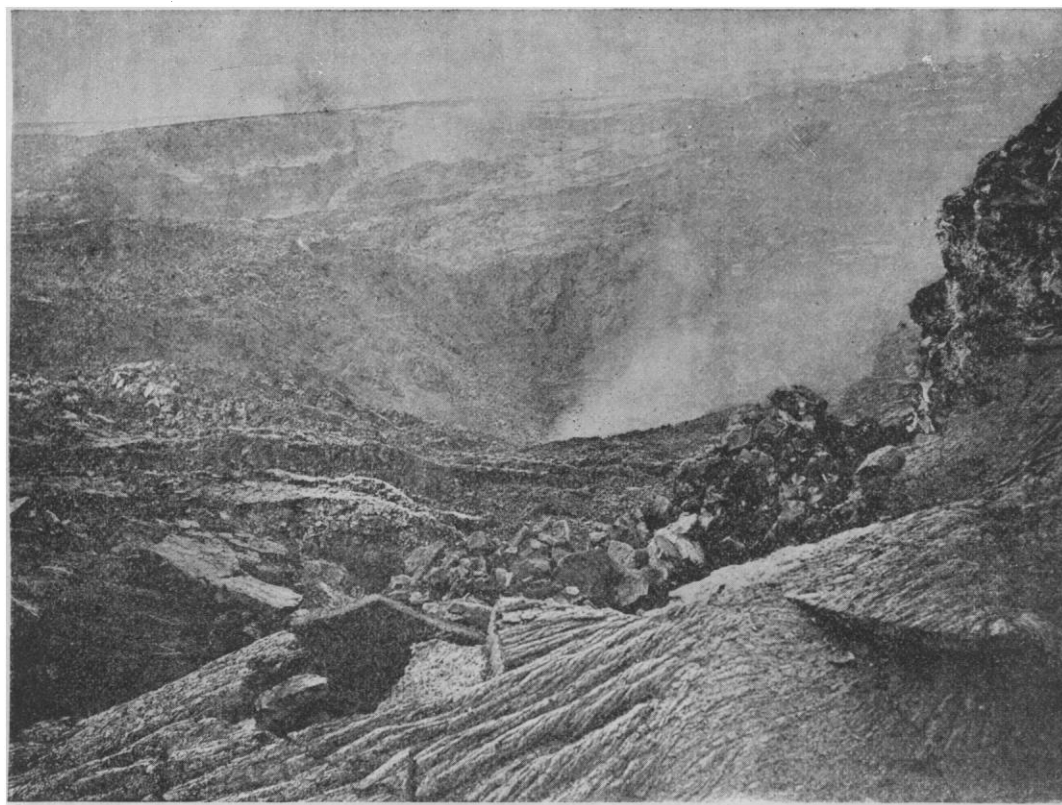


FIG. 2. — HALEMA'UMA'U AFTER THE DISAPPEARANCE OF LAVA IN APRIL, 1886.

region. The first (fig. 1) shows the space occupied by New Lake. The steep wall was the edge of the molten lava, and the depth 165 feet. In both views the precipitous walls constitute the new black ledge.

The second (fig. 2) shows the pit of Halema'uma'u. The lava reached very nearly to the top of the cliff before the eruption. The general level of the depression is similar to that of the bottom of New Lake, and the central pit is well shown with the steam and sulphurous gases rising

deepest pit a hole about forty feet across, descending at an angle of eighty or eighty-five degrees to a lake of fire. Great volumes of steam and sulphur vapor poured out of this orifice, whose walls were lined with sublimed sulphur and Pele's hair. As the opening lay in the midst of loose blocks of lava and widened out downwards, it was dangerous to stand near the edge; but the swashing of the liquid was distinctly audible, and stones thrown down were heard to splash into the liquid. The depth to the lava was probably about two

hundred feet. To the northward about two hundred feet was a copious discharge of corrosive vapors, which increased in strength in the course of the following week. At night the fire could be seen above the pit, just as at our earlier visits. It was evident the fire had returned to Kilauea; and the drooping spirits of the proprietors, who had made extensive preparations for the entertainment of tourists, began to revive. On the 25th of June a still larger vent opened upon the west side of the deep pit, or rather two of them. Two lakes of fire formed, divided by a very narrow ridge, early at the level of the deepest part of the pit

south a stretch of volcanic sand and *débris* fully equal in dimensions to Kilauea itself. On examining more closely the material called 'sandstone' and 'gravel' upon the map, it was seen to consist of material ejected from the volcano, and numerous lava-bombs were picked up. Ashes also cover the country to the south and south-west over the Kau desert for several miles. The conclusion is therefore forced upon us that the earlier eruptions varied in character from any thing that has been observed during the last half-century. Ashes, sand, and stones were thrown to a distance of several miles from the volcano; so

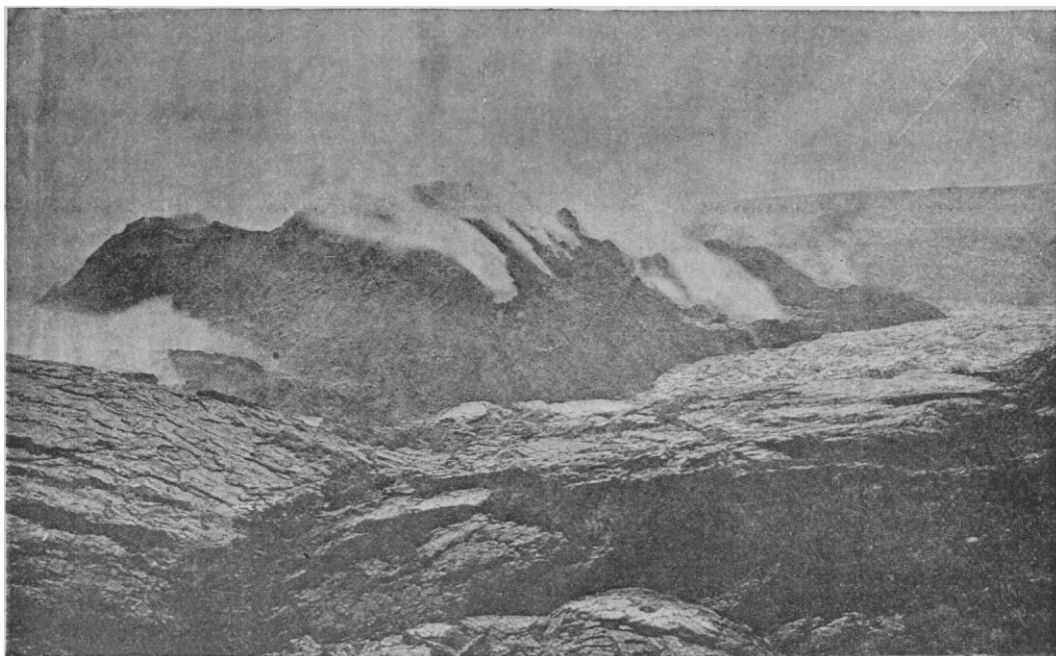


FIG. 3. — THE NEW HALEMA'UMA'U, AS SEEN EARLY IN OCTOBER, 1886.

(at least 800 feet below the Volcano House), and having a length of 700 feet and a width of 400 feet. About the same time the lava flowed out of the small opening of June 4, and is filling up the deep pit. Professor Van Slyke of Oahu college reports that the pit was entirely filled up at the end of July, and that a conical mound is forming above it. This will probably develop into a second Halema'uma'u, occupying, as it does, exactly the same place as the old one. All the discharging vents are situated within the limits of the sunken area of the map.

Advantage was taken of our visit to explore the southern part of the caldera. Standing at Keana Kakoi, one sees to the south-west and

that the Vesuvian type of action has been sometimes exemplified here.¹ It was in the neighborhood of the Keana Kakoi that the army was suffocated in 1789, perhaps by the very eruption whose *débris* are now strewn over the surface, and it may have come possibly from Keana itself.

It is not generally known that in 1868 the lava of Kilauea discharged from a vent in the Kau desert seven or eight miles distant. It has been claimed by some that the flow at Kahuku in that

¹ Observations made in the sugar-plantation districts of all the islands suggest that the subsoil is probably derived from these aerial discharges rather than from the decomposition of lava or from a deposit beneath the ocean, as suggested by Captain Dutton.

year came from Kilauea. The best authorities, like Dutton, agree that the Kahuku flow came from Mauna Loa, while Kilauea overflowed in the Kau desert. The area of the flow is only about a quarter of a mile in length and breadth.

It is worthy of note that after the eruptions of 1823, 1840, and 1886, the returning lava has stood at nearly the same level. That of 1823, described by Ellis, is estimated by Dutton to have been 400 feet lower than at the time of his visit. Reducing the figures to a uniform standard reference to the sea-level, the altitude in 1823 was 3,177 feet; in 1840, 3,170 feet; in 1886, 3,140 feet, or the lowest point. In 1882 the level of New Lake was estimated at 3,577 feet. The highest level of March 6 was at 3,719 feet. It appears, therefore, that there has been no essential change in the normal natural level of the molten lava for the past sixty-five years.

By advices sent as late as the middle of October, it appears that the central cone has risen 700 or 800 feet above the lowest level of the pit, and it is still rising. Small streams of lava issue, play around, and harden between the central cone and the walls of the pit; so that the old Halema'uma'u is being restored (fig. 3).

During the months of September and October Professor Alexander employed parties to make a further survey and map of the great caldera. The result is given in the annexed map after the sur-

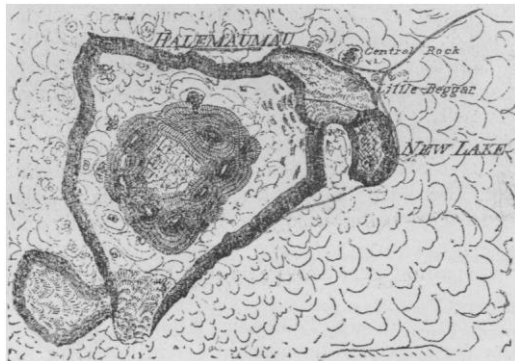
veys. Instead of the deep pit in the centres 900 feet below the Volcano House, there is a circular ridge nearly 600 feet above that lowest point. The lava which commenced to flow June 4 has continued to discharge ever since, and has now built up this crater. There is a sort of moat between the crater and the black ledge surrounding it as well as the central pit within. There is represented also an interesting patch of Aa to the north of Halema'uma'u.

C. H. HITCHCOCK.

PARIS LETTER.

IN a paper recently read before the Biological society of Paris, Dr. Debierre gave the results of researches concerning the physical superiority of the right side of the human body. Since the experiments of Harting, Sappey, Jobert, Concet, Milne-Edwards, and others, it has been generally accepted that in right-handed persons the right side is larger, longer, and heavier than the left side. To ascertain whether this disparity exists in early life, or is afterwards developed by education, Dr. Debierre experimented upon the dead bodies of young children, and found that, where education and practice had not interfered, there was no difference in size or weight between the right and left limbs. This is well, so far as it goes, but there must be some reason for the superior development by education of the right side. Even if we admit that education is the only reason for this superiority, we must believe that some circumstances in the foetal development, or in the conditions governing the nervous centres, are favorable to it, as it is so general, unless we believe that the first man was by special design created right-handed. But this belief I think no naturalist would accept.

As a consequence of the troubled international relations on our continent, — a state of affairs prejudicial to thought and business alike, and which will end some day in a tremendous crash and most foolish and unprofitable waste of human energy and life, — chemists are busily engaged in seeking improved methods of destruction. In France a new explosive has been devised, said to be as much superior to nitro-glycerine as the latter is to common gunpowder. It is called 'melinite,' and its explosive force is to that of gunpowder as 100 to 5. Its destructive effects are fearful, inasmuch as bombs charged with it do not explode immediately upon striking a wall, or similar resisting surface, the explosion taking place some little time after penetration. This new war material is the invention of MM. Locard and Hiron-dard of Bourges, to whom the minister of war has given an order for 200,000 bombs charged with



HALEMA'UMA'U IN OCTOBER, 1886.

veys of F. S. Dodge. The earlier map of Emerson was based upon the sketch of W. T. Brigham, made in 1866, and any general changes of outline observed are due to the greater precision of Dodge's survey. One observes differences in the northern wall, the straightening of the cliff in front of Kilauea-Iki, the more satisfactory representation of the two side-craters, and the location of the promontory at the old sulphur-beds. Halema'uma'u itself shows changes between these two latest

it. In Germany a new shell has been devised, on principles made known some years ago by M. Turpin, a French inventor. In this new projectile two substances, one of which acts as igniter and the other as combustible, are placed close to each other, but not in contact. The igniter is contained in a glass bottle, which is broken by the shock caused by the striking of the shell, thereby permitting the two substances to come into contact and causing the explosion at the desired moment. Neither of these substances is dangerous in itself, and either may be handled separately without risk. The projectiles are not charged with the igniting substance until they are to be used. A third new explosive has been invented in Berlin. It is called 'roburite,' and has given good results, but it is dangerous to handle, and is said to deteriorate more or less rapidly after manufacture.

Miss Klumpke, whom I mentioned in my last letter as having competed for the *internat* of the Paris hospitals, has been successful, passing as number 16, the whole number of competitors being about 600. She is an American, from San Francisco. Another American lady has been appointed *interne provisoire*, to be on duty only in case supplementary *internes* are necessary and for one year instead of four.

As I stated in my last letter, female students are pretty numerous in Paris. Most of them are Russians, generally very poor, so they club together in small sets, — many of them have brothers or husbands with them who are students also, — and put their resources into a common fund. One room is used as dormitory, another as study, etc., and a single cook does for all, — phalansterism as proposed by Fourier. They work hard, and the life of all, men and women, is very respectable in every way.

At a recent meeting of the Biological society a paper on paralytic rabies in man was read by M. Gamaleïa, a physician of Odessa, and director of the Russian antirabic inoculation institution in that city. One of M. Peter's main assertions in his discussion with Pasteur is that paralytic symptoms are met with only in rabbits and in cases of experimental hydrophobia; genuine hydrophobia, according to M. Peter, being always convulsive. M. Gamaleïa shows that such is not the case, and gives the records of sixteen cases of paralytic rabies witnessed by himself. The symptoms induced by this sort of hydrophobia are as follows: ataxy, paresis, and paralysis of the legs and arms, sensibility being unimpaired (at the outset, at least); lumbar pains, shooting from the back forwards; paralysis of the abdominal and rectal muscles. The paralysis gains ground, invading the neck, tongue, and face, and finally asphyxia sets

in. Among the causes which seem to co-operate in inducing the paralytic form of rabies, M. Gamaleïa notes especially the penetration of a large quantity of virus. This certainly was the case with the patients who died after submitting to Pasteur's intensive method.

The government report on fisheries for 1885 has just been published. The fishing vessels of all descriptions number 23,877, manned by 85,915 men. There are also 57,088 fishermen who fish along shore. The total weight of fish taken was 187,000,000 kilograms, valued at 92,736,585 francs. There has been a complaint for some years past of the increasing scarcity of sardines. These fish seem to stop in the neighborhood of the Spanish and Portuguese coasts, not going much farther north. The deaths among the fishermen for the year mentioned number 363, leaving 212 widows and 416 orphans. Were it not for the high freights charged by the railroads for the transportation of fish, the fisheries would be much more prosperous than they are, the high freights preventing the development of new markets. This is especially the case with oysters. In Brittany, for instance, oysters are so very abundant that at present they sell at nine francs per thousand, while in Paris they sell at fifty francs, owing to the high price of transportation and the local duty.

The telephone experiments which recently took place between Paris and Brussels were very satisfactory. The line was opened to the public some days ago, when a lively chat took place between the invited guests of the minister of posts and telegraphs, and those of the post-director of Brussels. Within the city the wire is inclosed in wooden tubes enveloped by a leaden tube. For the rest of the distance it is an ordinary aerial line, the wire being of siliceous bronze, — the same wire being used for both telegraphic and telephonic purposes. The tariff for five minutes' conversation between Paris and Brussels is three francs.

Some days ago Professor Alglave, the able director of the International scientific series, in France, delivered an interesting public lecture on alcoholism. He stated that of one hundred insane persons, forty had been intemperate; that fully one-half our criminals had been in the habit of drinking to excess, and that delirium tremens kills 2,200 persons every year. The reason for the increase in the death rate of alcoholic patients is not that there are a greater number of victims, but that alcoholic liquors are much more poisonous than formerly, owing to their poorer quality and the addition to them of inferior alcohol made from rice, potatoes, corn, beets, etc. Of 1,872,000

hectolitres of alcohol consumed annually, scarcely 25,000 hectolitres are pure ethylic alcohol made from grapes, — and other alcohols are real poisons, as may easily be shown. To kill an animal it requires about 7 grams of ethylic alcohol per kilogram of the animal's weight, while of amylic alcohol it requires only about 1 gram. To produce death in a man of 80 kilograms weight, it would require 620 grams of the pure alcohol, but only 88 of the other. Alcoholism is therefore produced seven times sooner with the latter than with the former.

It is now fifty years since the first railroad was built in France, and the fiftieth anniversary is being celebrated in the Bois de Vincennes. But the railroad companies prefer to wait and celebrate this anniversary during the exhibition of 1889, so it is likely that the present celebration will be a failure.

At a recent meeting of the Academy of sciences, M. Hayem of the medical school read a paper on the phenomena noticed in the head of an animal after decapitation, with or without transfusion of fresh blood. As soon as the head is separated from the body the eyes move convulsively, and a look of wonder and anxiety is noticeable on the face. The jaws separate with force, and the tongue seems to be in a tetanic state. There appears to be some consciousness of what is going on, but this does not last more than three or four seconds. The eyes then shrink into the head, and some spasmodic efforts at breathing are made; the nostrils expand, the mouth opens, the tongue is retracted towards the fauces. This respiratory effort is repeated three or four times, but the senses seem to be inactive, and the will is lost. These phenomena last one or at most two minutes, and the head then becomes utterly inert. If preparations have previously been made so that the head after separation continues to receive a fresh supply of blood, the voluntary manifestations persist as long as the blood supply is sufficient, — that is, for half an hour or so. When a blood-supply is furnished after the head has become entirely motionless, the phenomena are as follows: some contractions, very weak and feeble, take place, especially in the muscles of the lips; then some respiratory efforts; reflex actions of the eye, first weak, then well marked, but the eyelids remain drooping; the senses are quite asleep, and no will is manifested. Of course, the longer the period between decapitation and the restoration of blood supply, the longer the time before these phenomena are apparent. In conclusion, it may be assumed that decapitation does not produce instantaneous death. Conscious life and feeling continue for a few sec-

onds. Whether or not pain is felt during this brief period cannot be ascertained, most likely not, owing to the rapid death of nervous elements, with which alone sensation is concerned.

M. J. Schoenfeld has recently devised an ingenious method of written communication between blind persons and those who can see. Instead of printing the letter *p*, for instance, in relief as in other systems, a combination of pointed projections or stops, — as we will call them for convenience, — is used. These stops are of conical form, such as may be produced upon one side of a piece of paper by pressing lightly upon the other side with a sharply pointed pencil. The number of stops used is six, arranged in two parallel columns of three each, thus ::, and numbered consecutively from one to six, 1, 2, and 3 running down the first column, and 4, 5, and 6 down the second. In this system the letter *o* is represented thus :-, and *r* thus :-, — and as these signs are in relief they may be read as well by the eye as by the touch. The letter *o*, as we perceive, is a combination of the stops numbered 1, 3, and 5, — 2, 4, and 6 being omitted. The letter *r* is composed of the stops numbered 1, 2, 3, and 5; and so on, each letter being represented by a different combination of two or more of the stops. By the aid of a list of all the combinations used and of the letters to which they correspond, this system is easily learned, and it may be as easily read by the blind as the relief print now used.

A very useful though little known laboratory in Paris is that devoted to anthropometry, as applied to the identification of criminals. It is popularly called the 'Feet-bureau.' The reason for this peculiar name will be found farther on. In this laboratory every criminal, when taken into custody, is submitted to a thorough anthropometrical examination. He is divested of all clothing, and the form and dimensions of his head, face, fingers, feet, body, etc., are accurately noted down, and his face is photographed. There is already a collection of some sixty thousand photographs, and how can any particular photograph in this large collection be quickly found when required? This is the way M. Bertillon, the able director of the bureau, has classified them, so that he can readily find a photograph by which to identify any criminal whose picture is in the collection. The photographs are divided into three groups, according to the age of the criminal. Each of these groups is subdivided into three classes, according to the height of the person. A further subdivision of these classes is based upon the length of the head, and a final subdivision is governed by the length of the feet, — hence the name 'feet-bureau.' By this arrangement any desired picture among the

sixty thousand may be found in a moment, and on the back of it is a complete record of the criminal's past life, together with an accurate description of him. The bureau is very serviceable, the criminals being the only ones who find any fault with its workings.

An interesting paper upon the physiological action of saccharine — discovered some years ago by Fahlberg — has been contributed by MM. Aducco and Mosso. They find that frogs cannot live in a solution of this substance, on account of its acidity, though strong doses of a concentrated solution of it do not seem to affect them. Upon dogs, saccharine has no definite action. The weight of the animals is not changed by its use, and it has no effect upon the quantity or quality of the urine voided. Chlorides seem to be ejected in greater proportion, but this is all. Saccharine passes through the body without change, its only effect being to render the urine less putrescible than usual. Upon man the effects are similar, five-gram daily doses having no effect whatever, passing away wholly with the urine, entirely unchanged. Upon the whole, saccharine seems to be an inoffensive substance, having the valuable quality of being a substitute for sugar without the injurious effects of the latter in certain ailments, such as diabetes.

An excellent work upon hygienic dietetics has recently been published by M. Dujardin-Beaumetz, in which he ably reviews previous works upon the physiology of digestion, and advances sound ideas of what dietetics must be as governed by the various states of health and disease. Another work, by M. Dangeard, upon the inferior organisms, will prove useful to zoölogists and botanists. It is a book of reference concerning a very small division of protozoa, but contains no general ideas upon physiology or morphology. V.

Paris, Feb. 11.

GEOGRAPHICAL NOTES.

Africa.

The European population of Algiers in 1886 numbered 261,500 French and 210,000 foreigners. Among the latter the Spanish element is the most numerous. As among the French population there are 38,000 soldiers, and about a thousand foreigners are naturalized every year, the foreigners actually outnumber the French. The European population has doubled during the last twenty-five years, and the native population, which numbers 3,300,000 Arabs and Kabyles and 43,000 Israelites, is increasing at a rate of about 80,000 a year. Since 1881 the increase was 423,000.

Stanley publishes a letter in which he states

that all the political authorities and experts in Cairo are opposed to the idea of his taking the Kongo route for reaching Emin Pasha. As his expedition will be well armed, they do not consider the obstacles he would find on the Karagwé or Masai route insuperable. Stanley, however, wishes to avoid a struggle with Uganda, as he fears that the missionaries now in Mwanga's power will be murdered in case of war. He estimates the length of the Kongo route at 157 days, — twenty days by steamer from Zanzibar to the Kongo, three days by steamer on the Lower Kongo, thirty-five days on the Upper Kongo, and ninety-nine days of land journey to Lake Mwootan. The Karagwé route he calculates at 156 days land journey, the Masai route at 154 days.

No news has been received of Mr. Lüderitz, who went on an exploring expedition in southwestern Africa last fall. He has not been heard of since he embarked on the Orange River in a canoe.

Dr. E. Holub's party has been attacked by the Bechuanas, and his companion was killed in the fight. Holub escaped unhurt. After the news of this disaster was received, a committee was formed in Vienna to raise funds for enabling Dr. Holub to resume his explorations on the upper Zambezi.

The French are making use of their occupation of Madagascar, says *Nature*, to gain a thorough knowledge of the natural history of the island. There have already issued from the national press several fascicules of a magnificent '*Histoire physique, naturelle, et politique de Madagascar*,' edited by M. Alfred Grandidier, to be completed in thirty volumes quarto. The subjects to be comprised in this work are: 1°, physical and astronomical geography; 2°, meteorology and magnetism; 3°, ethnology, anthropology, and linguistics; 4°, political, colonial, and commercial history; 5°, natural history of mammals; 6°, natural history of birds; 7°, natural history of fishes; 8°, natural history of reptiles; 9°, natural history of Crustacea; 10°, natural history of terrestrial and freshwater mollusks; 11°, natural history of plants; 12°, geology and paleontology. The various sections are intrusted to competent authorities; and the geological portion is to be illustrated by about five hundred chromo-lithographs or colored plates, the anatomical details being represented in lithography and photography. The total number of plates will not be less than 1200.

America.

Mr. Chaffanjon was going to leave San Fernando de Atabapo on the Upper Orinoco in November, 1886, to explore the sources of that river. Through the support of the government he got

some Moquivitaes Indians for guides. They are the neighbors of the Guaharibos, who occupy the district of the sources of the Orinoco. The latter are very much feared by the whites, as they murder everybody who tries to enter their country. Chaffanjon hopes through the help of his Moquivitaes friends to be able to gain their confidence and accomplish his purpose. On his way to San Fernando he made interesting linguistic and archeological researches.

Oceania.

It is stated by *Nature* that the lake district in New Zealand is showing signs of fresh disturbances. Tremors have been felt at Rotorua, and Tarawera has emitted dense volumes of steam. The Wahanga Peak appeared most active. No fire was visible, and after this outburst everything quieted down again.

On the 15th of January a new volcanic eruption took place on Hawaii.

Oceans.

The Proceedings of the Royal geographical society for December, 1886, contain an interesting paper by J. Y. Buchanan on 'Similarities in the physical geography of the great oceans.' The author mainly discusses three important oceanographical problems, — the equatorial current, the equatorial counter-current, and the rising of cold water near the coasts of continents. Buchanan describes the influence of the evaporation which takes place in the region of the dry and warm trade-winds and monsoons. The water which gets warmer but more concentrated sinks under the colder layers of less concentrated water, and thus becomes a medium of transportation of heat into the deeper strata. As this warm water is moving west, it reaches its greatest depth in the western parts of the oceans. As corals are confined to regions of warm water, they principally live in the same area. While the region of the equatorial current has water of great density, the equatorial counter-current has lighter water, and wherever the velocity of the eastern current is increasing, its density is decreasing. Buchanan does not give an explanation of the origin of the counter-current. His observations on the density agree with the well-known fact that the current lies beyond the belt of trade-winds which effect a rapid evaporation. The mechanical cause of this current remains still doubtful, though it seems probable that the equatorial current is its principal cause. Buchanan's remarks on the rising of cold water near the coasts of continents are of great interest. Formerly the existence of cold water was considered a sufficient proof for the

existence of cold currents. Recent researches, however, make it probable that in such places cold abysmal water rises from the adjoining depths. Buchanan shows on a map that the cold water is principally found on windward coasts of the oceans, where the currents are flowing from the continent. The loss of water in these regions is made good by the rising cold water. The January number of the *Annalen der hydrographie* calls our attention to the fact that wherever a current is deflected from a coast, it attracts the adjoining water. It depends on the configuration of the ocean whether the abysmal water or that of the adjoining surface takes the place of the water that is carried away by the current. The rotation of the earth is the principal cause for the deflection of the currents and the consequent rising of the cold water. Every coast-current in the northern hemisphere is deflected to the right, in the southern to the left, and in all these places cold water may be observed.

General.

The February number of the *Scottish geographical magazine* contains a paper by John Murray on the total rainfall of the globe, and its relation to the discharge of rivers, accompanied by a map showing the distribution of annual rainfall. According to Mr. Murray, 2,243 cubic miles of rain fall annually on areas with inland drainage. Such areas extend to 11,486,350 square miles. The land draining directly to the ocean has an area of 44,211,000 square miles. If from this quantity we subtract all areas having less than 10 inches of annual rainfall, we get 38,829,750 square miles. The mean discharge from this area into the ocean is 6,569 cubic miles annually. The total weight of substances carried by this means to the ocean is rather more than 5,000,000,000 tons each year.

NOTES AND NEWS.

THE cholera epidemic is now declining in the Argentine Republic, having entirely disappeared from Cordoba. It still prevails in Montevideo, and has recently broken out at Frey Benitos, where the Liebig company has its slaughter-houses and factories for the preparation of the extract of meat. The La Plata River is closed to navigation on account of the epidemic. Although cholera has declined in the interior of the Argentine Republic, there is no change in the city of Buenos Ayres. There is no news from Paraguay, but it is learned from the Brazilian province of Matto Grosso that cholera is doing great havoc there. At Corumbá the people are terror-stricken and have fled into the interior. Fear is now enter-

tained that these refugees may spread the cholera into Goyaz and possibly into the Amazon region and to Pará.

— Following a period of apparent stagnation, due to the final arrangements as to site, programme, details of building, and the laying-out of the grounds, advices from the headquarters of the directors of the Paris jubilee of railways state that activity now prevails on the grounds, and that the palace and equipment will be ready for the opening in May.

— Messrs. Ticknor & Company announce for publication, on Friday, Feb. 25, 'The life and works of Giordano Bruno,' a new volume of the English and foreign philosophical library; 'The course of empire,' being outlines of the chief political changes in the history of the world, arranged by centuries, with variorum illustrations, by C. G. Wheeler, author of 'Familiar allusions,' with twenty-five maps; and 'Familiar allusions,' a handbook of miscellaneous information, including the names of celebrated statues, paintings, palaces, country-seats, ruins, churches, ships, streets, clubs, natural curiosities, and the like, by William A. Wheeler and Charles G. Wheeler.

— At a late meeting of the New York academy of medicine, Dr. J. H. Girdner read a paper on the methods of detecting and locating metallic masses in the human body by the induction balance and the telephonic probe. He referred to the apparatus which had been constructed by Professor Bell for the purpose of locating the bullet in the case of President Garfield, and said that it had failed because at the time the patient was lying on a metallic mattress, which interfered with the working of the instrument. Now we have an apparatus which will detect and locate any piece of metal, wherever situated in the human body. In the construction of the induction balance a bichromic battery is used, with six cells, and an ordinary interrupter, the interruptions being about six hundred to a second. The exploring coils were put in a framework of wood, which Professor Bell called the 'explorer,' while to the others the name 'adjusting coils' was given. Thus in the primary current were two coils, in the secondary current were also two coils, and in the circuit was a telephonic receiver. When the exploring coil was not in relation to a metallic substance, there was silence in the telephonic receiver; but, as the explorer approached or receded from the metallic mass, the balance was disturbed, producing a musical tone in the receiver. The sound is distinct six inches from the metal, if located in the human body. The telephonic probe consists of a telephonic receiver and two wires,—one ter-

minating in a long, slender steel probe; and the other with a steel plate laid over the surface of the body in the neighborhood of the metallic mass, as determined by the induction balance. The steel probe being now plunged into the body, as soon as it reaches the metal a distinct click is heard. The practical working of the instrument was shown by locating a bullet in the chest of a soldier wounded during the civil war. A piece of lead was also recognized in the centre of a piece of beef.

— Sir J. William Dawson will prepare a volume for the International scientific series on the subject of the development of plants in geological time.

— The article by Prof. N. S. Shaler of Harvard, on 'The stability of the earth,' in the March *Scribner's*, will be accompanied by very numerous illustrations, which throw light upon the subject of earthquakes and other movements of the earth's crust.

— The persistence with which surgeons continue to employ chloroform as an anaesthetic in surgical operations, notwithstanding the overwhelming evidence of its danger, is beyond comprehension. We have called attention to this subject whenever deaths have resulted from this cause, and the number of such events has been considerable. Another has just occurred in Philadelphia. A lion-tamer in the service of Forepaugh had one of his fingers bitten by a colored man, and in the course of his treatment chloroform was administered. It is said that he died upon the table while still under the anaesthetic.

— Lieutenant Emory will sail early in March, in command of the *Thetis*, one of the Greely expedition relief-ships, for the Alaska coast.

— The U. S. fish-commission steamer *Albatross* is being fitted with new boilers, and will sail in the spring for her work on the Pacific, where, among other questions to be solved, will be that of the fish-bearing properties of the huge Kiu Sawa or Black Stream of Japan, which, crossing the Pacific in a high latitude, modifies the temperature and climate of Alaska and the Aleutian Archipelago in very much the same way that the Gulf Stream does the climate of England and the Shetland Islands.

— Dr. Gabriel E. Manigault of Charleston, S.C., has accepted the invitation of the geological survey to write a descriptive account of the incidents and effects of the earthquake of Aug. 31, 1886, for the forthcoming report on that subject. Dr. Manigault is an accomplished naturalist, and is curator of the museum in Charleston. He was in

the city at the time of the earthquake, and has since made a careful investigation of its incidents.

— Major Powell, director of the geological survey, in a statement which he has furnished for publication, says that there is no present likelihood of iron ore being exhausted in this country; but the remedy for prospective exhaustion is still further exploration for the mines to which the geologist points in various parts of the country.

— Commissioner Colman of the department of agriculture has issued a circular relating to the so-called 'Australian rabbit.' He says that the name is a misnomer, the animal being the common rabbit of Europe, which has been introduced in Australia. He recites its ravages in that country, and says that the introduction of the European species would be an unnecessary and hazardous experiment. He suggests that congress pass a law conferring upon the commissioner of agriculture the power to prevent the landing of any animal, bird, or other pest, in any port of the United States that in his opinion would be injurious to agriculture, in the same way that cattle infected with contagious diseases are now prohibited from entering our ports. He cites the case of the English sparrow, to show that it is unwise to transplant species which crowd out the native ones.

— We learn from the *Sidereal messenger* for February that Chicago may lose its astronomical observatory. The Dearborn observatory is the property of the Chicago astronomical society, but is upon ground leased to it by the now extinct University of Chicago, and may be required to vacate upon sixty days' notice. The society has received a request to transfer its instruments and library to an institution of learning outside of Chicago, but an effort is being made to obtain another site within the city.

— Another small comet was discovered by Barnard on the evening of Feb. 16. It is visible in a three-inch telescope. The great southern comet seems to have vanished as suddenly as it came. Though careful search has been made for it, we believe it has not been seen in the northern hemisphere.

— Nine comets passed the sun in review during the year 1886. One was a well-known periodic comet returning at the appointed time; and two of the new-comers appear to be moving in elliptic orbits, one of them identical, possibly, with De Vico's lost comet of 1844, or at least belonging to the 'same family' as the latter. Olbers' comet of 1815, which was expected at perihelion in December, 1886, has not been detected, but, as an uncertainty of over three years exists in the time of

revolution, it may be picked up during the coming year. It is the only periodic comet expected in 1887. Two out of the nine comets were discovered in 1885, one in 1887, leaving six for 1886. Three were visible to the naked eye. Three belong to Barnard, three to Brooks. Two were found by Finlay, and one by Fabry. Comet 1886 IX. was picked up by three observers independently on three successive mornings in October, showing what a careful watch is kept for these little wanderers. Mr. Warner has paid eight hundred dollars in prize-money for the captures.

— As a result of the attempts to bring to pass an earlier publication of the Proceedings of the American association, the Proceedings of the Buffalo meeting held last summer were published during January of this year. Heretofore the Proceedings have not been published much within a year after the date of meeting. This promptness in publication has resulted partly from the reduced volume of the Proceedings, and partly by obliging the authors of papers to furnish abstracts prior to the time of reading them. Several of the addresses and reports were in type and stereotyped before the meeting, and others were held in type ready to be incorporated in the order of printing.

— The annual meeting of the Davenport academy of sciences was held in that city Jan. 26. The past year was one of unusual activity in the society, and large accessions were made to the collections.

— In the *Boston medical and surgical journal* we find an extract from the *Annales d'hygiène et médecine légale* which gives the observations of a French physician, Dr. Masson, on the footprints which are sometimes found at the scene of a murder, and the aid which they furnish in the detection of the perpetrator of the crime. The point which was especially studied was whether the marks discovered were made by one and the same foot, and so by one person only. He found that the same foot would give footprints with very different dimensions, according as it was used in standing or walking, corresponding with the two essential functions of the foot, as an organ of locomotion and of support. It appears to Dr. Masson impossible that two human footprints should closely resemble each other unless the same foot has made them. The impression made by a foot discloses such clear characteristics, the distinctive marks under different conditions are so numerous, the footprints of the same foot are so alike under dissimilar circumstances, that an attentive expert, having good footprints to study, ought to arrive at clear and precise conclusions. The toes, the great toe especially, leave marks that

should be examined attentively. These, and the outline of the digito-plantar depression, the line which defines the plantar arch, are the data for diagnosis. The conclusions which Dr. Masson draws, are, 1°, the dimensions and the shape of footprints made by the same foot vary with the attitudes taken; 2°, the two extreme and characteristic types are represented by impressions made by the foot in walking and in standing; 3°, the expert called to study the matter of footprints should always take impressions of the foot of the accused in the act of standing and of walking, and should compare only those which correspond with the same attitude; 4°, in connection with the measurements made, one should always consider the points which throw light upon the individual characteristics of the foot.

— We have received the first volume of the publications of the observatory ('History and work of the Warner observatory') founded by Mr. H. H. Warner of Rochester, N.Y., about six years ago, and now well known through its connection with the Warner comet prizes. The volume is published by Dr. Lewis Swift, the director, and gives a description of the observatory (a tower attached to the dwelling of the director) and the instruments, and a list of over four hundred nebulae discovered since July 9, 1883. About two-thirds of the pamphlet are taken up by 'The Warner prize essays.' These are, an essay on 'Comets; their composition, purpose, and effect upon the earth,' by Prof. Lewis Boss of the Dudley observatory; and four essays on the sky-glows, by Professor Kiessling, and Messrs. Clark, Maine, and Bishop respectively. The principal instrument of the observatory is an excellent 16-inch Clark equatorial provided with a filar micrometer and many convenient accessories. Its equipment is to be increased by a spectroscope, to cost \$1,000, ordered from the Clarks. The observatory is also provided with a 4½-inch comet-seeker. Dr. Swift has devoted himself almost entirely to the discovery of new nebulae, and the search for comets, a field in which he has had nearly thirty years' training. It would seem ungracious to comment upon any of the shortcomings of the report; we suggest, however, that the usefulness of the observatory as an astronomical institution might be greatly increased if the director were provided with a thoroughly competent assistant, in order that his own work of discovery may be supplemented by careful study and measurement. It should be noted that Mr. Warner has expended more than \$4,500 in astronomical prizes since Oct. 10, 1880.

— It seems that professors in Italy are chosen by a method that seems to be purely national.

We quote from a recent article by R. Bonghi:— "For those who do not know, I should mention that in Italy the university professors are elected by the system of *concorsi*, for which there seems to be no exact English equivalent, and the particular method adopted has been altered several times, but is now the following: The faculty in which a professor is wanted proposes to the minister five names of ordinary professors of the subject for which a teacher is needed, or of cognate subjects, and if the minister approves of them he appoints them as a committee. To it every native or foreigner who thinks himself adapted for such a chair can send in his *titoli*; that is, his academic degrees and the books he has written. The committee, in a more or less explicit report, judges who is eligible, who not, and who among those considered eligible deserves the first place. Such a judgment presupposes that all the members of the committee should read and ponder carefully the books sent in by the candidates, but the general opinion is that they do not do so. It is commonly supposed that they meet with their minds already made up, and that they are proposed and nominated in such a manner as to insure their coming to the decision which will please either the faculty that proposes them or the minister who nominates them. This may not be true in all cases, but in some it doubtless is. At any rate, the report of the committee is then sent up to the superior council (of public instruction), which has nothing to do but to see that all due forms have been observed; which forms naturally always are observed, unless through some oversight in the drawing-up of the report."

LETTERS TO THE EDITOR.

Left-handedness.

ON p. 148 of the current volume of *Science*, mention is made of Dr. Wilson's view as to the cause of left-handedness.

In connection with this, Dr. Thomas Brown's suggestion in his 'Vulgar errors' (London, 1658) may be quoted. It occurs in the chapter, 'Of the right and left hand.'

"And therefore the brain, especially the spinal marrow, which is but the brain prolonged, hath a fairer plea hereto; for these are the principles of motion, wherein dextrality consists; and are divided within and without the Crany. By which division transmitting nerves respectively unto either side; according to the indifferency, or original and nativity prepotency, there ariseth an equality in both or prevalency in either side."

He does not lay much weight on this, for his conclusion is, —

"And thus have we at large declared that although the right be most commonly used; yet hath it no regular or certain root in nature." B.

Lexington, Va., Feb. 21.

SCIENCE.—SUPPLEMENT.

FRIDAY, FEBRUARY 25, 1887.

BIOLOGY AND SOCIOLOGY.

IN an article entitled 'Revolution and evolution,' printed in the *Contemporary review* for September, Mr. Leon Metchnikoff wages war against the opinions of those who would draw a close parallel between the biological relations of a community of zooids and the sociological conditions under which an ideal association of human individuals must occur.

According to Metchnikoff, there is a complete antithesis between the laws of the sociological and the biological domains; for the first have to do with aggregations of individuals maintained by *co-operation*, 'conscious or unconscious,' while the second concerns only groupings which are based on *struggle*. Then the author admits the occurrence of the sociological law in the biological community, but still strictly insists that individual struggle and communal co-operation are two forces of different kinds. He says (p. 432), "Whenever we see a phenomenon of association,—be it in the shape of a vegetable or animal organism, or that of a more perfect human community,—we cannot fail to detect something new, as essentially distinct from the law of individualistic competition or struggle as that specific Darwinian law itself is distinct from the Newtonian universal law of gravitation. That something is, namely, the consensus of a number of more or less individualized forces aiming at an end, not personal to one of the allies, but common to them all, and that is what we call *co-operation*." The conclusion seems to be, that, when we rise from the biological into the sociological domain, we can carry nothing useful from our toilsome studies on the way in which the organisms of nature have been built up and preserved, but must seek out a new law of deliberate altruistic co-operation, which is represented as having no relation to the natural impulse of the individual toward his own advancement.

Far from presuming to deal directly with so complex a question, it is the object of this paper to present the truth as regards one side of the problem by discovering, if possible, the true communal relations of the simplest *differentiae* making up the most complex animal body. It will be pointed out that biological data indicate no final antago-

nism between co-operation and struggle, but, on the contrary, that the one is the necessary antecedent of the other.

Living matter or protoplasm has, apparently, in all its forms, the same general functions; and such a study of relation as that proposed ought, if carried out on right lines, to lead us to a conception of the philosophy of protoplasm, by which is understood the main impulse or motive guiding individual and determining collective action.

Whatever may be the present and future subjects of biological dispute, the tidal wave of thought has lifted and grounded firmly beyond the danger of overthrow one grand general idea,—that every living organism may be anatomically analyzed into a greater or less number of physiological units—the cells or modified cells—which contain the living matter, and which, in function, though not in form, are like the parts they go to make up. The accuracy of this analysis is not affected by the differentiation of the cells themselves, nor would conclusions from it be disturbed should each cell itself be proved to represent a community of discrete factors.

It has come to be a fundamental doctrine of physiological teaching, that the higher animals may be looked upon as communities of living cells or modified cells whose functions determine the action of the organs they compose, and which are bound together by more or less not-living, intercellular matter, made, or at least modified, by the cells; and yet it appears that some of the most evident and important consequences that arise from this communal relation of different individuals, having needs and powers of all grades of similarity and dissimilarity, have been generally neglected or misunderstood. The analogy between the animal cell as related to the organism, and the human individual in his entirety as related to society, is a very striking one.

The cells of a body all take their nutriment from the same general pabulum: they all have the same general needs; and as the food-supply is a result of constructive effort, and therefore limited in quantity, there must be a struggle for food (or a struggle for existence) among the cells, which would be more severe the more nearly alike their individual needs. This statement will bear an illustration. We know that a blood-free muscle may, by artificial stimulation, be reduced to complete exhaustion; but, if a nutrient solution like blood-serum be now passed through the blood-

vessels, the muscle-substance, by virtue of its chemical affinities, extracts certain matters from the supply-fluid, and recovers its irritability and contractility. Now, we know that this unstable muscle-substance is continually being oxidized with the production of certain waste products. Suppose that the affinities of a given muscle-fibre for food matter are so feeble that less nutriment is brought in a given time into the tissue than is lost in the way of waste: the result is a gradual decadence or atrophy of that muscle. As in the physiological condition the food-supply is limited, those muscle-fibres with strongest constructive chemical affinities rob the weaker fibres, which could only get their fill, as it were, by a modification of physiological activity throughout the whole body. This explanation of the relation of growth to competition probably partly underlies the well-known fact of the extraordinary growth of one of a pair of similar organs, as a kidney, when its fellow is extirpated.

Owing to the physiological division of labor among the tissues, each one of these has come to depend nearly absolutely upon organs far removed for some of the essentials to its welfare: as, for example, a gland is often called upon during secretion to pour out a bulk of material greater than its own volume, and for the performance of this function there is an alteration of vaso-motor activity through which more blood visits the gland in time of need; and this vascular change, as also the secretion itself, is directly controlled by nerve-centres lying in the distant brain. So, elsewhere in the body, we are continually coming upon phenomena in which the working tissue appears to derive little direct benefit from its effort; the activity of each organ seems determined by, or at least co-ordinated with, the needs of its fellows; and this fact, indeed, constitutes the very definition of physiological activity.

If we invent a physiological allegory, whose personages are the animal cells supposed to be endowed with sensibility, reason, and motion, like in kind to the faculties of complete organisms, we should find that the fanciful sketch of the cellular society constructed on such a scheme corresponds remarkably well, if not identically, with the actual result of such associations of cells as we find them in living organisms. The apparent altruism noted above is perhaps most marked in the working of the respiratory nerve-centre on whose rhythmic impulses directly depends the contraction of the respiratory muscles which expand the chest, and thus draw into the lungs the fresh air necessary to the life of the whole body.

This nerve-centre is generally supposed to be composed essentially of a group of nerve-cells oc-

cupying an insignificant area of the brain; and on their ceaseless, rhythmic output of energy every living molecule of the body each moment derives benefit without giving any manifest adequate return. Still, though each new study of the body brings to view fresh examples of the subservience of individual needs of the physiological units to the welfare of the community of cells, it can be shown as scarcely doubtful that this altruism, apparently purposive on the part of the living integers, is but an indirect outcome of an effort for their own aggrandizement, their supreme selfishness, as it were. There is the strongest reason to believe that the physiological individual, or cell, in a complex organism, is primarily as completely bent upon its own nutritive welfare, and as regardless of the condition of its neighbors, as if it were a free monad contending for sustenance against a myriad of its fellows in a culture-solution. Even in the case of the action of the respiratory centre, which seems devoted purely to aims benevolent to the organism as a whole, experiment indicates that any such benefit conferred outside the centre itself is, as it were, a mere accident in its activity.

It is the present belief of physiologists that the nerve-cells of the respiratory centre are stimulated by a lack of oxygen to discharge energy into the motor nerves arising from them; and their discharges, up to a certain point, increase in vigor with diminution of oxygen-supply, and conversely become weaker and less frequent when that gas is in excess in the blood. If oxygen fail totally, the cells soon die. Now, suppose an animal to be in a state of respiratory quiescence: oxygen is still being drawn from the blood by every living tissue. As a result of this, there is failure of oxygen in the respiratory centre; and a stimulus of some sort is heaped up in the nerve-cells there, until finally an explosion of energy proceeds from them into their motor nerves, and thence to the muscles of inspiration which cause the chest to expand. Thereby fresh air is drawn into the lungs, new oxygen diffuses into the blood, and thus the excitement of the respiratory centre is allayed for a while, presumably owing to the oxidation in the centre of some irritating chemical products of tissue-change.

It has been found, that, if the manner of circulation is artificially so altered in a living animal that the brain still receives blood oxidized to its normal arterial condition, while tissues of the trunk or limbs get only venous blood or even none at all, the rhythmic action of the respiratory centre goes on undisturbed, though the organs with altered circulation soon die from asphyxia. On the contrary, should the arteries conveying

blood to the brain be clamped, thus cutting off the oxygen-supply and abolishing the removal of waste, or should the blood passing through them be artificially warmed, thus hastening the chemical changes in the nerve-centres without a corresponding increase in the rapidity of food-supply and waste-removal, the deep and energetic breathing of dyspnoea soon shows the pressing need of the centre for fresh oxygen; and the animal may die, as far as its brain is concerned, in the convulsions of asphyxia, though the great bulk of its body is unaffected, and lives on in perfect rest so soon as the exhausted brain can no longer stir its muscles to contraction.

If we arrange a narcotized living animal in such a way as to observe the changes in the amount of its arterial blood-pressure while supplying air by artificial respiration, it will be observed that the pressure rises when the respiration fails ever so little, and the elevation is most marked when the muscular contractions of extreme dyspnoea appear. Now, it is this arterial pressure which drives the nutrient blood on its way. The blood-current is stronger and swifter, the greater the pressure; and the result of such a change is to present each tissue with a more abundant supply of oxygen and other food-materials. The rise of pressure noticed in the first instance was due to the contraction of the living walls of the blood-vessels throughout the body: they responded directly, or were made to respond indirectly through their motor nerves, to the need of the oxygen in their local areas and in the brain; and the result of this action was to supply with all despatch the respiratory centre with whatever store of oxygen there was in the blood. So we have the all-important fact of the mutual helpfulness of the bodily tissues on the one hand, and the respiratory nerve-cells on the other, brought about by the independent exertion of each living factor of the body in its own behalf. Every physiologist knows experimentally how the whole body rises in protest, as it were, at any interference with the free performance of the respiratory functions; and that little group of cells whose business it is to initiate the movements of breathing are thus protected from want by every part of the body, which is itself dependent on them. A complete record of all such co-ordinate actions would form a treatise on physiology, and a consideration of all the results justifies this generalization: that every physiological unit of a complex organism labors for its own aggrandizement alone; but its existence is conditioned by an association with neighbors, with which it must compete and upon which it depends; and this union has the suggestive result that every living cell in the body receives aid

and protection from its neighbors in proportion as it, in turn, by its activity, furnishes them with aid and protection.

This remarkable union of the energies of the morphological elements of the body, which suggests so clearly the social relations of an ideal community, finds its explanation in the ground law of the doctrine of evolution. If we but presume the fact of a struggle for existence among the tissue-factors, the survival of the fittest must be a corollary to that proposition; and the fittest individual is that whose life best tends to preserve the welfare of the organism as a whole, for on this depends the existence of each of its constituent parts.

The farther we peer into the mysteries of the living animal, new utilitarian beauties are disclosed with every secret unfolded; and the time is probably not far distant when it will be difficult to point out a structure or function which, far from being simply useless, has not a definite purpose aimed at preserving the safety or perfecting the economy of energy-discharge of the whole body. Even if one bears in mind the well-known criticism on the imperfection of the eye as an optical instrument, his view would be one-sided and unjust if content to rest there. The errors of normal vision are nearly all errors of judgment; which is a subjective process, and it is presumable that finer workmanship in the optical camera would be useless in arousing sensations of greater advantage to the organism.

From a physiological point of view, the physical environment of an animal has only a remote though a certain and most complex relation to changes in the organism. Now, any change of the environment must be followed by a kaleidoscopic alteration in the relations of the tissues among themselves, and these may be very profound without any necessary variation of the total vital configuration. Dr. Romanes, in his recent exposition concerning physiological selection as a means of accounting for the origin of species, has done good service in looking directly at the independent variable—the animal cell—in seeking a solution of the intricate problem presented by the body as a whole.

If this analogy between the communal relations of living cells in the body and those of individuals in human society have a foundation in fact, we ought to be able to use the parallel as a path of research, and, from what is known concerning the evolution of society, gain light as to the physiological relation within parts of the body which yield their facts very sparingly to investigation.

A well-known physiologist has called the central nervous system the final battle-ground of the

science. If we look upon these mysterious nerve-cells as a community of reasoning individuals, we should expect to find a division of labor among them which should restrict more or less completely the physiological activity of each anatomical area. What we know of the subject justifies this comparison. We find the nerve-cells of the medulla and spinal cord inheriting automatic and reflex powers of comparatively simple character, but of vital importance to the life of the whole system; and there is reason to believe that these powers are more extensive and efficient the longer they have been impressed by heredity. When we ascend from the medulla to the cerebellum, we come upon powers of the same kind, but vastly more complex in their co-ordinations; and here, or hereabouts, we meet a new faculty,—that of *learning* reflexes, or learning to carry on a complicated action with machine-like definiteness and celerity in obedience to a given stimulus. The complex motions of walking, balancing, the performance of an experienced pianist, are largely reflexes whose centres, in all probability, lie in this part of the brain. Then we gradually rise through nerve-centre after nerve-centre, with graduated physiological powers, till we reach the Teacher himself, whose energy is, doubtless, that of the cortical cerebral cells. Nothing is clearer in physiology than this general differentiation of function among the nerve-centres, and it is altogether probable that a physiological differentiation even goes hand in hand with the morphological one which histologists have shown to involve the matter making up the individual animal cell itself.

Looking at the cortical cells again as a community, we should expect that the complex of powers of the society should be divided up and portioned off to distinct individuals which should inherit extreme facility of action in a definite province without altogether losing the other, now subordinated, functions with which they were originally endowed. Artificial stimulation of definite cortical areas we should expect to be followed by a manifestation of their specific function; and, on the contrary, annihilation of such a region ought to be followed by a corresponding paralysis, which would not be permanent, because neighboring cells would gradually develop the lost function, the power to perform which had hitherto been latent in them. Each new lesion would be followed by a crippling involving the same features, and the recovery would each time be less perfect. This presentation may be taken, as far as the results go, as the actual outcome of experimentation on the brain; and the same history would be repeated by any civilized community in which the various trades and pro-

fessions should, in turn, be deprived of their workers.

Physiological phenomena are those in which the activities of various tissues are co-ordinated in such a way as to produce a combined action; and we may consider each tissue-element as a reasoning individual which associates physiologically with its neighbors only so far as a result of this union is beneficial to its own welfare.

Turning now from the normal body to view the phenomena of pathology, we enter a field which has been too incompletely surveyed for us to trace our way at will in it; but so far as pathological processes are understood, they seem to be guided by the same law of endeavor for self-aggrandizement on the part of the living cells concerned, as in those actions already considered. When an arterial wall becomes cheesy or chalky in atheroma as a result of increased arterial strain, we see living tissue-elements redeveloping some of their suppressed embryonic powers of metabolism, and replacing their sentient, overworked protoplasm by an inert substance incapable of either evolving energy or suffering from overstrain. Unfortunately this ostrich-like hiding of the head is an ill-judged attempt at self-preservation; for it entails increased labor on other organs, which may result in fatal inco-ordination. So, also, when a foreign particle within the body is encysted by an envelope of tissue developed for that purpose, the whole process goes on as if the active cells had distinctly in view the covering-up of a hurtfully irritating object.

Those pathological processes which are more usual grade imperceptibly into the physiological; as, for instance, those phenomena of altered circulation and growth attending the healing of the fracture in a broken bone.

Only a competent pathologist could give full force to the proposition here stated: but there seems to be convincing evidence that in pathological as in physiological processes there is a distinct effort, on the part of the acting protoplasm, towards self-aggrandizement; that is, to reduce its expenditure and to increase its income of energy. In the physiological process the various factors work together in such a way that the resultant effort is of the greatest possible benefit to each separate member without detriment to any other. In an extreme pathological action the selfishness of some single individual brings ruin on the whole organism, because regardless of the fact that unlimited self-aggrandizement is hurtful to the remainder of the community. We may profitably compare these two biological conditions to the states of discipline on shipboard as they may be observed respectively in calm weather and during great

excitement. In the first instance every movement is carried out, and every duty is performed, with relation to a common purpose,—the most complete welfare of ship and crew; but no one can doubt that the individual motive of each sailor is to thereby bring the greatest benefit to himself. In the unusual occurrence of threatened shipwreck, however, this co-ordination is lost, because the selfishness of each individual in seeking his own safety causes him to disregard the duty he owes his companions, and the result is fatal inco-ordination.

If what we have said be true, the premise assumed by Metchnikoff is fundamentally wrong. The doctrine of evolution applied to the living organism teaches, not that there is final antagonism between struggle and co-operation, but that co-ordination and the well-being of the whole is the natural outcome of struggle for existence among the individual particles of the body; and, presuming capability of variation, there must, through 'survival of the fittest,' come to be increase of specialization and perfection of performance in every function. Fatal or merely injurious pathological processes, when traced to their source, are found to be due to accidents which do not come under the head of uniform law. Supposing such an accident to occur so frequently as to become a normal event: the vital elasticity of the organism re-adjusts itself to these new conditions involved, so that they (as in the case of the bone-fracture) are hardly distinguishable from ordinary physiological processes.

HENRY SEWALL.

THE BRITISH COMMISSION ON THE DEPRESSION OF TRADE.

IN response to a general feeling of anxiety, some of it expressed openly and some not, a royal commission was appointed some months since by the British government to take into consideration the depression of trade and industry in Great Britain, and to report by what means, if any, the depression could be remedied. The final report of the commission has recently been published, and it bristles with points of both theoretical and practical interest. The report is by no means unanimous. A majority report is signed by the late Earl of Iddesleigh, the able president of the commission, and eighteen of his fellows. Eleven of these, however, sign under certain restrictions and reservations, which they append over their respective signatures. The minority report, which represents the views of the so-called fair-trade party, is signed by Lord Dunraven and three

others. A third report is submitted by Mr. Arthur O'Connor, and signed only by himself.

The majority report begins by mentioning the general points of agreement among all the witnesses examined. These are said to be, 1°, that the trade and industry of the country are in a condition which may fairly be described as depressed; 2°, that this depression takes the form of a diminution, and in some cases an absence, of profit, with a corresponding diminution of employment for the laboring classes; 3°, that neither the volume of trade, nor the amount of capital invested therein, has materially fallen off, though the latter has in many cases depreciated in value; and, 4°, that this depression dates from about the year 1875, and that, with the exception of a short period of prosperity enjoyed by certain branches of trade in the years 1880 to 1883, it has proceeded with tolerable uniformity, and has affected the trade and industry of the country generally, but more especially those branches which are connected with agriculture.

This unanimity did not extend, however, to the causes which brought the depression about. But those causes to which any great importance was attached were, 1°, over-production; 2°, a continuous fall of prices, caused by an appreciation of the standard of value; 3°, the effect of foreign tariffs and bounties, and the restrictive commercial policy of foreign countries in limiting English markets; 4°, foreign competition; 5°, an increase in local taxation; 6°, cheaper rates of transportation enjoyed by foreign competitors; 7°, legislation affecting the employment of labor in industrial undertakings; 8°, superior technical education of foreign workmen.

It is pointed out that it is from the employers of labor and producers that most complaints of trade-depression have come; but the report adds, that its signers are satisfied that in recent years, and particularly in the years during which the depression has prevailed, the production of commodities generally, and the accumulation of capital in the country, have been proceeding at a rate more rapid than the increase of population; and in support of this the statistics as to pauperism, education, crime, and savings banks, are cited. The statistics of foreign trade show an apparent falling-off in some respects; but this is attributed almost entirely to the continuous fall in prices, especially those of raw materials, since 1873. After making allowance for this fall in prices and for the fall in the price of raw materials, it is held that the actual products of British labor and capital have largely increased. It is pointed out, for example, that, if valued at the prices current in 1873, the aggregate of the foreign trade of Great

Britain for 1883 would have amounted to 861,000,-000 pounds sterling, instead of, as it appears now, 667,000,000 pounds sterling.

This conclusion, however, is untrue in the case of agriculture, where it is found that the quantity of produce raised in Great Britain during the last few years has materially decreased, and the steady fall in prices has been felt even more severely than the diminished yield of the soil; and it is the section of the community interested in agriculture which the commission finds particularly affected by the depression. The complaints as to absence of profit, though general, are not uniform. The evidence shows, however, that while business is not absolutely less in quantity, it is carried on with the smallest possible margin of profit, and in some cases with no profit at all. Nevertheless it is pointed out that the gross amount of property and profits assessed to the income-tax in the years 1885 and 1886 is much larger than that of any previous year. Too much stress cannot be laid upon these figures, because the increase of the income-tax assessment is in great degree attributable to the increased efficiency of collection. It is further stated that in some cases the tax is paid on profits not earned, because of the unwillingness of traders to make known the fact that they have sustained losses.

But the absence or diminution of profits is not the only marked feature of the prevailing depression, though it is the most universal one. The supply of commodities is found to be in excess of the demand, and the natural tendency to equilibrium between them seems to have been obstructed for an unusually long period. And this excess of supply is maintained in the face of unremunerative prices. The chief features of the commercial situation are thus summed up: 1°, a very serious falling-off in the exchangeable value of the produce of the soil; 2°, an increased production of nearly all other classes of commodities; 3°, a tendency in the supply of commodities to outrun the demand; 4°, a consequent diminution in the profit obtainable by production; and, 5°, a similar diminution in the rate of interest on invested capital. The diminution in the rate of profit obtainable from production, whether agricultural or manufacturing, has given rise to the wide-spread feeling of depression among all the producing classes. Those, on the other hand, who are in receipt of fixed salaries, or who draw their incomes from fixed investments, have little to complain of. The same thing is true with regard to the laboring class, so far as the purchasing power of wages is concerned. Some distress is created among the laboring classes by the displacement of labor, which is always in progress

owing to the increased use of machinery and other changes of production; and last winter this distress was aggravated by the severity of the weather.

The report then takes up the causes which the signers believe have assisted to produce the depression. It goes on, "we have shown that the production of the more important classes of commodities has, on the whole, continued to increase; and there can be no doubt that the cost of production tends to diminish. It is difficult, therefore, to understand how the net product of industry, which constitutes the wealth of the country, can have failed to increase also. There is, moreover, sufficient evidence that capital has, on the whole, continued to accumulate throughout the period which is described as depressed, though there has been a sensible depreciation in the value of some kinds of capital. How, then, are we to account for the general sense of depression which undoubtedly exists, and is becoming perhaps more intense every year?"

The view which the signers of the majority report adopt is that the aggregate wealth of the country is being distributed differently, and that a large part of the prevailing complaints and the general sense of depression may be accounted for by the changes which have taken place in recent years in the apportionment and distribution of profits. The reward of capital and management has become less, and the employment of labor is, for the time at least, not so full and continuous; so that even where the rate of wages has not been diminished, the total amount earned by the laborer has been less, owing to irregular or partial employment. Setting aside the classes immediately dependent upon agriculture for their incomes, and considering those only engaged directly in commercial enterprises, it is found that the total amount of profits on which the income tax has been paid has increased, as has also the number of persons assessed. In the decade from 1875 to 1885 the number of incomes assessed under schedule D of the income-tax list, amounting to £200 or more, increased from 184,354 to 239,367, a gain of nearly thirty per cent. But the increase was much more rapid at the lower end of the scale than at the upper; for it seems that the number of persons with incomes of less than £2,000 a year has increased at a more rapid rate than the population, — which during the period in question has increased about ten per cent, — while the number of person with incomes above £2,000 has increased at a less rapid rate, and the number of persons with incomes above £5,000 has actually diminished. The rule is, the lower the income the more rapid the rate of increase. The conclusion

from this is, that, whether profits are increasing or not, there is direct evidence that profits are becoming more widely distributed among the classes engaged in trade and industry, and that, while the larger capitalists may be receiving a lower return than that to which they have been accustomed, the number of those who are making a profit, though possibly a small one, has largely increased.

The signers recognize the fact that over-production may exist for a time and in certain branches of industry, and that it tends to correct itself. But they are more or less at a loss to account for an over-production at once so general and so long-continued as the one under consideration has been. They are disposed, however, to explain this as the effect of the protectionist policy of so many foreign countries, which has become more marked during the past decade than ever before. "The high prices which protection secures to the producer within the protected area naturally stimulate production, and impel him to engage in competition in foreign markets. The surplus production which cannot find a market at home is sent abroad, and in foreign markets undersells the commodities produced under less artificial conditions."

A share of the blame, if blame it can be called, for the depression, is laid upon the working of the limited liability system. Under this the capital invested in small sums by a large number of individual shareholders is, as a rule, contented with a lower rate of interest than the ordinary producer will require upon the capital which he employs at his sole and unlimited risk. The tendency of limited liability companies is also to undertake enterprises with regard rather to the creation and speedy sale of the shares at a premium than to their permanent prosperity. The limitation of the liability further serves to encourage a less cautious or more speculative system of trading than can safely be pursued by a trader who is himself liable for the full extent of his operations. The report offers no opinion as to the benefit derived by the community at large from the limited liability companies, but simply points out the important influence which they have exercised both upon the extent of production and the rate of profit obtainable on the capital employed in it. The fact that stocks held by middle-men have become available for consumption without replacement, because of the more rapid and direct communication between the producer and the consumer, has tended to depress prices and profits; and there is also to be taken into consideration the fact that the possibilities of new demands throughout the world are becoming annually more

limited: it is consequently predicted that in future more stability in the ratio of supply to demand may be expected, with a more regular though reduced rate of profit.

The report next considers at much length the fall of prices. The reasons for this may be briefly enumerated as an appreciation of the standard of value, a decreased demand both in domestic and foreign markets, — the latter attributed in large degree to the operation of protective tariffs, — and the fact that the reputation of British workmanship does not stand as high as it once did. The fraudulent stamping of foreign goods of inferior quality with British marks has had something to do in bringing about this result; and many witnesses before the commission believed that legislative restrictions on labor, and the action of the working-classes themselves in increasing the cost of production by strikes, and so forth, have had an important effect. The majority report, however, dissents from the view of these witnesses.

When it comes to the question of remedies for the depression, the report becomes more vague and indefinite. The cost of production must be cheapened so far as is consistent with the maintenance of sound quality and good workmanship. The increasing severity of foreign competition must be met. New markets must be sought for. Technical and commercial schools must be developed and improved until they are equal to those on the continent of Europe. Legislation is needed to make more effective the provisions of the existing laws as to the counterfeit or fraudulent marking of goods. The law as to limited liability companies is susceptible of improvement, though the report fails to point out how. The report then concludes, "We think that while, on the one hand, the information which we have been able to collect will tend to dispel much of the apprehension which appears to prevail on the subject of our commercial position, and to encourage a more hopeful view of the situation, it will also show, that, if our position is to be maintained, it must be by the exercise of the same energy, perseverance, self-restraint, and readiness of resource, by which it was originally created."

The minority report is of interest, because it embodies the views of Lord Dunraven and his fellow-advocates of fair trade. In its analysis of the depression, it is in almost entire agreement with the majority report; its individuality consists in its recommendations. It mentions and approves the remedies outlined by the majority of the commission, but finds that they leave untouched the greatest and most permanent causes of the depression, which are the action of foreign

bounties and tariffs, and the growing effect of directly or indirectly subsidized foreign competition. These are not natural, but artificially created difficulties. They will increase rather than diminish. To counteract them it is not recommended that a like system of import duties be established, but the minority believe that "a slightly preferential treatment of the food-products of India and the colonies over those of foreign nations would, if adopted as a permanent system, gradually but certainly direct the flow of food-growing capital and labor more towards our own dependencies and less towards the United States than heretofore. When it is noted that in the year 1884 the Australian colonies, with only 3,100,000 inhabitants, purchased £23,895,858 worth of our manufactures, while the United States, with about 55,000,000 inhabitants, purchased only £24,424,636 worth, it will be apparent how great would be the effect of a policy which should lead to the more rapid peopling of the Australian colonies in giving fuller employment to our working-classes at home, and thus increasing the healthful activity of the home trade, as well as the import of raw materials for our various industries to operate upon."

It is thought that "specific duties, equal to about ten per cent on a low range of values, imposed upon the import from foreign countries of those articles of food which India and the colonies are well able to produce, would sufficiently effect this purpose. Their adoption would, of course, involve the abolition of the heavy duties on tea, coffee, cocoa, and dried fruits, which are now levied on Indian and colonial, equally with foreign, produce. It would widen the basis of our revenue, and render us less dependent upon the sustained productiveness of the income-tax and the duties upon intoxicating liquors; and, what is even more important, it could not fail to draw closer all portions of the empire in the bond of mutual interests, and thus pave the way towards a more effective union for common objects. For there would be no exclusion of foreign food-products: they would come in on payment of the duty named; and we are convinced, that, if any effect were produced upon the prices of the articles in question, it would be very slight indeed, and limited in duration to the time required, under the stimulus of preferential treatment, to increase the production of them in India and the colonies."

Besides this, a duty of 2s. 4d. per hundredweight on sugar is advocated to offset the sugar bounties. "Its effect would be to restore to the producers of sugar in our colonies and in India, and to the refiners in this country, the just right of competition on practically equal terms, and to transfer to our own exchequer the export bounties given by

foreign nations. The position of the British consumer would be the same as if we had by negotiation obtained an equivalent reduction of the bounties, while in his quality of tax-payer he would be a gainer by the diversion of foreign money into our exchequer so long as the bounty-receiving importations continued."

These are the main features of the reports which have been looked for with considerable interest by the commercial classes and economists both in this country and in England. How far future legislation will embody their recommendations, and how successful they will be if enacted into laws, remains to be seen.

As a substitute for gunpowder, dynamite, or other explosive requiring ignition, Dr. Kosman proposes, for use in mines containing inflammable gases, cartridges filled with dilute sulphuric acid and zinc-dust (the mixture of finely divided zinc and zinc oxide that collects in the condensers of the zinc retorts). The cartridge-case is a glass cylinder divided into two chambers, one being four times the capacity of the other. The larger chamber contains the acid, the zinc-powder being placed in the other when the cartridge is about to be used. The cartridge is inserted in the shot-hole in the usual manner, a 'shooting-needle' being first passed through the zinc-powder to a plug in the partition separating the two chambers. The shot-hole is then tamped in the ordinary way, the end of the needle projecting at the surface. A tap on the needle displaces the plug and breaks the glass partition, when a rapid evolution of hydrogen takes place with sufficient expansive power to do the work of the explosive cartridge, but without its danger.

— General Lefroy, formerly director of the Toronto observatory, who is considered to be the best authority on terrestrial magnetism in Canada and the British possessions, pays the following compliment to the work done by the United States in this direction: "The United States appear to be in advance of most European countries in current knowledge of the facts of the earth's magnetism, but the magnetic survey of the British Islands is again in progress, and we shall soon be up to date again." In this connection it may be well to state that France has just made a magnetic survey of its area, and in England the third one is now being made; central Europe had but one magnetic survey; the Russians are alive to this important work; and Japan has just completed a fine survey, 200 stations occupied, with the curious result of a connection of the magnetic curves with the lines of folding of the geological strata.